

ROTARY MOTION POWERED LIGHT EMITTING DIODES

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TECHNICAL FIELD

10 The present invention pertains to decorative lights for motor vehicles in general, and more specifically, to a plurality of light emitting diodes that spin within the center of an automotive wheel, or wheel cover, with the light emitting diodes electrically energized by wheel rotation.

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BACKGROUND ART

20 Previously, many types of lights have been used in conjunction with vehicle wheels in endeavoring to provide a pleasing and unique visual effect. In most cases the illumination is provided by light emitting diodes (LED's) powered by conventional storage batteries.

The prior art listed below did not disclose patents that possess the novelty of the instant invention; however the following U.S. patents are considered related:

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	<u>Patent Number</u>	<u>Inventor</u>	<u>Issue Date</u>
	4,381,537	Hinrichs	Apr. 25, 1983
	4,562,516	Chastain	Dec. 31, 1985
	4,763,230	Cummings et al.	Aug. 9, 1988
30	4,800,469	Leon	Jan. 24, 1989
	4,847,735	Kawasaki	Jul. 11, 1989

Hinrichs in U.S. patent 4,381,537 teaches an automotive accessory consisting of a translucent disk wheel cover that overlays a supporting plate mounted on an axle. The plate includes individual lamps that are turned on and off in a desired sequence to provide
5 an illusion of movement such as spokes of a wheel.

Chastan in U.S. patent 4,562,516 discloses an illuminating spinner attached to an automobile wheel having its center hub cap removed. The spinner has a plurality of wings with apertures located in front walls and a central front opening covered by a cap. An adjustable adapter locks the spinner on the wheel, and electrical LED circuitry inside
10 the spinner provides illumination.

Cummings et al in U.S. patent 4,763,230 teaches a plurality of lights forming a string that is connected to an electrical power source. The string is interleaved between the spokes of a wheel.

Patent No. 4,800,469 issued to Leon is for a safety warning light that is mounted
15 on a valve stem on a wheel. The apparatus has a two-part housing with a LED on one side and a battery on the other, with a switch for control.

Kawasaki in U.S. patent 4,847,735 discloses a safety lamp for a bicycle or motorcycle. The lamp has a male thread for attachment to the air valve of the bicycle's or motorcycle's wheel.

20 For background purposes and as indicative of the art to which the invention is related reference may be made to the remaining cited design patent No. Des. 332,441 issued to Douglas, Jr.

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DISCLOSURE OF THE INVENTION

Automotive wheels have been a focal point for styling a motor driven vehicle for decades using after-market components. Tires have been subjected to many
30 changes, from different sizes both larger and smaller, white walls, wider tread, etc.

Further, the wheel's structure has been replaced with cast metallic types and wheel coverings have been produced in a wide variety of sizes, shapes and ornamentations. Lighting has also been produced to back-light the wheels, and attempts have been made to include lights preferably in the form of LEDs, due to their low power consumption and
5 extended life expectancy. It may be seen from the prior art that many types of illumination have been developed in conjunction with a vehicle wheel to enhance the wheel's appearance. The biggest problem with the use of LEDs is that a portable power source is required, which is obviously a conventional storage battery. While this approach is acceptable regarding its operational capabilities, the problem of replacement
10 rises as batteries have a limited life and must be changed when they have exhausted their power reservoir.

Therefore, the primary object of the invention is to overcome the use of batteries and to utilize an alternative power source that does not require replacement. This object is realized by using a permanent magnet generator that is small enough to fit inside an
15 automotive wheel center cap or spinner and remain in place without maintenance for the life of the vehicle.

An important and novel object of the invention is that the generator utilizes the rotation of the wheel to achieve its power producing capabilities. This unique feature is accomplished by using a rotating portion of the generator fixed to the wheel and a
20 stationary portion freewheeling using a counter-weight to maintain its relative motionless position. The generator will produce power any time the vehicle wheel is rotating and therefore does not require switches or controls to de-energize the power when the vehicle is not in use.

Another object of the invention is that the permanent magnet generator is
25 completely waterproof and robust enough to withstand the shock and vibration that results from being located within an automotive wheel center cap or spinner.

Still another object of the invention is that the generator is almost entirely fabricated of injection-molded components, with the exception of the axle bearings,

magnet ring and armature including coil windings. It is possible to use powered ferrous metal in the thermoplastic when magnetism is required for electrical production.

Yet another object of the invention is realized using injection-molded components which permits the cost to the public to be well within the reach of all and further large production quantities may allow additional cost reduction.

A further object of the invention is that the LEDs may be positioned at almost any location within the wheel cap since it is rotating with the stationary portion of the generator. This positioning permits an unlimited array of lights, colors and reflections.

Another object of the invention is that a translucent or transparent cap, again made of thermoplastic, may be used in conjunction with the LED's. As an example, an emblem, figure, icon, scene, design or even a reflective surface may be incorporated into the cap with any combination of light colors.

A final object of the invention is that the LED's may be mounted into wheel covers, on the spokes of a spoked wheel, on alloy wheels and even on the blade of a wheel spinner cover.

These and other objects and advantages of the present invention will become apparent from the subsequent detailed description of the preferred embodiment and the appended claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a partial isometric view of the preferred embodiment installed in the wheel of a typical automobile.

FIGURE 2 is a partial isometric view of a hexagonal nut knockoff and adapter enclosing the preferred embodiment of the invention.

FIGURE 3 is a cross sectional view taken along lines 3-3 of FIGURE 2 showing the permanent magnet generator, LED's and rectifier installed in the wheel's hexagonal nut knockoff and adapter.

FIGURE 4 is a partial isometric view of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 5 is a cutaway plan view of the permanent magnet generator in the preferred embodiment.

5 FIGURE 6 is a cross sectional view taken along lines 6-6 of FIGURE 5.

FIGURE 7 is a plan view of the base of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 8 is a cross sectional view taken along lines 8-8 of FIGURE 7.

10 FIGURE 9 is a plan view of the case of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 10 is a cross sectional view taken along lines 10-10 of FIGURE 9.

FIGURE 11 is a partial isometric view of the first axle bearing, shown by itself for clarity.

15 FIGURE 12 is a partial isometric view of the second axle bearing, shown by itself for clarity.

FIGURE 13 is a plan view of the axle cover of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 14 is a cross sectional view taken along lines 14-14 of FIGURE 13.

20 FIGURE 15 is a plan view of one of the armature laminations of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 16 is a cross sectional view taken along lines 16-16 of FIGURE 15.

FIGURE 17 is an arbitrary cross sectional view of a stack of armature laminations used in the preferred embodiment, shown by itself for clarity.

25 FIGURE 18 is an isometric view of the stack of armature laminations with the armature coil windings, shown with arrows as to their winding orientation.

FIGURE 19 is a schematic illustrating the armature coil windings with numbers corresponding to the numbers depicted in FIGURE 18.

FIGURE 20 is an isometric view of the axle of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 21 is a cross sectional view taken along lines 21-21 of FIGURE 20.

FIGURE 22 is an isometric view of the snap ring for the axle of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 23 is an isometric view of the tightening ring for the axle and magnet ring frame in the preferred embodiment, shown by itself for clarity.

FIGURE 24 is an isometric view of the magnet ring frame of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 25 is a cross sectional view taken along lines 25-25 of FIGURE 24.

FIGURE 26 is a plan view of the magnet ring of the permanent magnet generator in the preferred embodiment, with the magnetic polarity indicated with alpha symbols.

FIGURE 27 is a cross sectional view taken along lines 27-27 of FIGURE 26.

FIGURE 28 is an isometric view of the counter weight of the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 29 is a cross sectional view taken along lines 29-29 of FIGURE 28 illustrating the counter-weight installed on the case shown in phantom.

FIGURE 30 is a schematic diagram of the generator and the bridge rectifier along with the optional voltage regulator.

FIGURE 31 is an arbitrary cross sectional view of the adapter plate used in conjunction with the knockoff and adapter, shown by itself for clarity.

FIGURE 32 is an arbitrary cross sectional view of the dual bar spinner knockoff and adapter enclosing the preferred embodiment of the invention.

FIGURE 33 is cut-away view of the side of the dual-bar spinner knockoff of the preferred embodiment.

FIGURE 34 is cut away view of the side of the hex nut spinner of the preferred embodiment.

FIGURE 35 is an isometric view of the rectifier utilized in conjunction with the permanent magnet generator in the preferred embodiment, shown by itself for clarity.

FIGURE 36 is a plan view of the LED cap of the permanent magnet generator in the preferred embodiment having a chrome plated diamond internal shape, shown by itself for clarity.

FIGURE 37 is a cross sectional view taken along lines 37-37 of FIGURE 36.

5 FIGURE 38 is a plan view of the LED cap of the permanent magnet generator in the preferred embodiment having an eagle internal shape, shown by itself for clarity.

FIGURE 39 is a cross sectional view taken along lines 39-39 of FIGURE 38.

FIGURE 40 is a plan view of the LED cap of the permanent magnet generator in the preferred embodiment having a skull internal shape, shown by itself for clarity;

10 FIGURE 41 is a cross sectional view taken along lines 41-41 of FIGURE 40.

FIGURE 42 is an elevation view of the light emitting diodes disposed onto a number of spokes on a wire spoke wheel surrounded by a transparent sleeve held in place with adhesive.

15 FIGURE 43 is a fragmentary partial isometric view of light emitting diodes disposed onto a spoke on a wire spoke wheel surrounded by a transparent sleeve held in place with adhesive, with the sleeve shown partially wrapped around to illustrate the method of attachment.

FIGURE 44 is an elevation view of the diodes positioned within integral bars projecting radially from a wheel hub of an alloy wheel.

20 FIGURE 45 is an elevation view of a wheel cover with the diodes inserted through the outside surface of the cover.

FIGURE 46 is an elevation view of another variation of positioning the diodes on a wheel, wherein the diodes are positioned within the spinning blade of a wheel spinner cover.

BEST MODE FOR CARRYING OUT THE INVENTION

The best mode for carrying out the rotary motion powered light emitting diodes is presented in terms of a preferred embodiment with variations in locations of the light emitting diodes. The preferred embodiment, as shown in FIGURES 1 through 46, is comprised of three basic assemblies: a permanent magnet generator 20 to provide power, a bridge rectifier 22 to change the power from ac to dc, and a plurality of light emitting diodes, hereafter designated LEDs 24, to illuminate a pattern on a vehicle wheel.

The permanent magnet generator 20 is completely self-contained and is mounted inside an adapter within a vehicle wheel and produces electric power whenever the wheel is rotating. The generator 20 has two main elements: a rotating portion 26 and a stationary portion 28, as illustrated best in FIGURE 6. The rotating portion 26 utilizes a base 30, shown alone in FIGURES 7 and 8, and includes means for attaching the base 30 to a vehicle wheel center 32 in the form of a plurality of legs 34 that are integrally formed on the top of the base 30. For descriptive purposes, the base 30 has an inner surface and an outer surface, with a pair of connectors 36 penetrating the wall of the base in a sealed manner for electrically communicating the output power from the generator 20 while still providing a hermetic seal that protects the internal components of the generator from the elements.

A case 38 surrounds the outer surface of the base 30, as illustrated in FIGURES 5 and 6 assembled, and by itself in FIGURE 9 and 10. The case 38 has thin walls and is formed in a cup-like shape having a flat top and straight side walls which protect the internal components within the generator 20.

A pair of axle bearings 40 are pressed into the base 30 at spaced intervals into a set of race cavities 42, one from the outside and the other from the inside. The bearings 40 are the sealed ball bearing type, which are well known in the art and in common usage. The bearings 40 are shown assembled in FIGURE 6, and by themselves in FIGURES 11 and 12.

An axle cover 44 is positioned on the inner surface of the base 30 to cover the appropriate axle bearing 40, as illustrated in FIGURES 13 and 14. The cover 44 fits tightly into a recess in the base 30 and is flush with the inner surface of the base 30.

A plurality of armature laminations 46, wound with armature coil windings 48, intimately engage the base 30 by pressing into the base on a portion directly outside of the bearings 40, as depicted in FIGURE 6. The armature laminations 46 are shown alone in FIGURES 15 and 16, and stacked together in FIGURES 17 and 18. The laminations 46
5 may be made of ferrous metal or injection-molded in thermoplastic and have powdered iron included in the material to utilize magnetism phenomenon in the functional operation of the generator 20. The windings 48 consist of copper wire that is wound into the recesses in the lamination stack, as shown in FIGURE 18, with the schematic of the route depicted in FIGURE 19 showing the corresponding recesses by numbers between the two
10 drawings. An electromagnetic field is created by the rotation of the wound armature 50 when it is rotated inside a permanent magnet as described later with electrical power produced through the winding wire.

The stationary portion of the permanent magnet generator consists of an axle 52 that has a snap ring 54 on one end, with the axle 52 pressed into the inner races of the bearings 40, as illustrated in FIGURE 6. The end of the axle 52 opposite the snap ring 54
15 engages a tightening ring 56 that intimately grips the axle 52, thereby holding the axle 52 in place between the bearings 40.

The tightening ring 56 also grips a magnet ring frame 58 on its peripheral surface, interfacing in such a manner as to attach the frame 58 securely, thus permitting the frame
20 58 to rotate with the axle 52. The magnet ring frame 58 is sized to be entirely within the case 38 and to rotate freely with the stationary portion 28 of the generator 20.

A permanent magnet ring 60 is attached to the magnet ring frame 58 and is positioned over the wound armature 50, thereby leaving an air gap therebetween. The magnet ring 60 is magnetized with a plurality of opposed polarity poles at equal spaced intervals. With
25 this arrangement the permanent magnet generator 20 produces alternating current power when the rotating portion 26 and stationary portion 28 are in motion relative to each other.

The key to the invention is the use of a revolving means to rotate the permanent magnet generator 20 to supply alternating current electrical power. In order to obtain a

differential between the rotating portion 26 and the stationary portion 28 of the generator 20 a counter weight 62 is affixed to the magnet ring frame 58 on the generator's stationary portion 28. This counter weight 62 creates the required differential rotation of the permanent magnet generator when a vehicle wheel is turning the rotating portion 26, as gravity holds the weight 62 on the bottom of the stationary portion 28. The counter weight 62 is shown alone in FIGURES 28 and 29, with 29 illustrating the weight 62 attached to the frame 58 shown in phantom. FIGURES 5 and 6 show the weight 62 at the bottom of the stationary portion 28 as held by gravity, as the two portions are free to rotate independently.

The permanent magnet generator 20 utilizes a metallic construction material for the bearings 40, the magnet ring 60 and armature 50 including the armature windings 48, and thermoplastic for the remainder of the generator. It should be noted that powered ferrous metal may be used in conjunction with the plastic in order to obtain the proper characteristics, and the windings are preferably made of copper wire. Additionally any electrical interconnections between the generator 20 and the LED's 24 may be accomplished using conventional insulated copper wire, or the like.

Revolving means for rotating the permanent magnet generator 20 to supply alternating current electrical power comprises a vehicle wheel 64, as illustrated in FIGURE 1. In order to place the LEDs 24 in the wheel member 66, a spinner 68, a hex knock off 70 or a myriad of other hub cap arrangements including a center cap, a hub cap, a wheel cover, a wheel spoke or a spinner blade may be used, on trucks and automobiles. FIGURE 31 illustrates a spinner adapter base 72, FIGURE 33 shows a typical two bar knock off 74, FIGURE 34 depicts a hex knock off 76, and FIGURE 31 shows an assembly plate 78. The generator 30 is positioned within some type of base which is the same or similar to the adapter base 72, as illustrated in FIGURE 3 and 32.

With the generator 30 mounted in place in the base 72, the ac/dc bridge rectifier 22, which consists of a wheatstone bridge, is also mounted, in an optional location, within the same base and is in electrical communication with the generator 30. Power produced by the generator 30 is alternating current, as the poles within the magnet ring 60

determine the frequency relative to the speed of rotation. Since the rotating portion 26 of the generator 30 is revolved by the vehicle wheel 64, the rotational speed may vary. As an example, an average wheel rotating at a 5 MPH speed rotates approximately 78 RPM, and at 100 MPH the speed increases to approximately 1,530 RPM, which relates to a four pole generator producing a frequency of 2.5 HERTZ at 5 MPH and 50 HERTZ at 100 MPH. In order for the LEDs to operate, direct current is required; therefore the rectifier 22 is necessary. The rectifier 22 changes the alternating current from the generator 20 to a useable direct current for the LEDs.

In some cases with a multi-pole generator design, a voltage regulator 80 that is in electrical communication with the ac/dc bridge rectifier output may be required. Further, a current dropping resistor 82 may also be required in certain instances to limit the voltage to the LEDs 24.

The plurality of LEDs 24 are preferably disposed within the assembly plate 78 that is attached to the adapter base 72, as illustrated in FIGURES 3 and 31. The LEDs 24 penetrate a transparent or translucent cap 84 that is attached to the base 72 or the LEDs 24 may be attached directly to the cap 84 as desired according to the particular design selected. The cap 84 may contain a wide variety of designs and ornamentation, as an example the transparent cap 84 may include a reflective coating 86 on a faceted inner surface with the LED's disposed in a geometrical array around the reflective coating. The cap 84 may also have an image 88 molded into the interior of the cap, such as the examples illustrated in FIGURES 36-41. Additionally, there is no limitation to the types of images, designs, indicia, symbols etc. that may be utilized.

The plurality of light emitting diodes 24 may also be disposed onto a plurality of spokes 90 on a wire spoke wheel 92 surrounded by a transparent sleeve 94 held in place with adhesive or the like, as illustrated in FIGURES 42 and 43. The diodes 24 may also be positioned within the integral bars 96 projecting radially from the wheel hub or center portion of an alloy wheel 98, depicted in FIGURE 44, or through a wheel cover 100 as shown pictorially in FIGURE 45. Another variation of positioning the diodes 24 on a

wheel is illustrated in FIGURE 46, wherein the diodes 24 are positioned within the spinning blade 102 of a wheel spinner cover 104.

In operation, the generator 20, rectifier 22 and LEDs 24 are mounted into the adapter base 72 with the cap 84 covering the LEDs 24 so as to permit visual indication
5 from the outside. The base 72 is mounted on a vehicle wheel 64 in a conventional manner and the LEDs are static in the "at rest" position. When the vehicle starts and the wheels begin, to rotate the LEDs are energized by the generator 20 and continue to light as long as the wheel 64 is rotating. The visual appearance of the invention produces a ring or a number of rings according to the matrix or orientation of each LED 24. Further,
10 stationary images may be viewed through the transparent cap 84. The LEDs 24 may be easily flashed on and off with the addition of well known solid state circuitry. Once the invention is attached to the vehicle's wheel no further maintenance, switching or replacing batteries is required.

While the invention has been described in complete detail and pictorially shown
15 in the accompanying drawings, it is not to be limited to such details, since many changes and modifications may be made to the invention without departing from the spirit and scope thereof. Hence, it is described to cover any and all modifications and forms which may come within the language and scope of the appended claims.

ROTARY MOTION POWERED LIGHT EMITTING DIODES

Element Designation

(For convenience of the Examiner, not part of the specification)

	20	generator
5	22	rectifier
	24	LED's
	26	rotating portion (of 20)
	28	stationary portion (of 20)
	30	base (of 26)
10	32	vehicle wheel center
	34	legs (of 30)
	36	connectors
	38	case
	40	axle bearing
15	42	race cavities
	44	axle cover
	46	armature lamination
	48	armature windings
	50	wound armature
20	52	axle
	54	snap ring
	56	tightening ring
	58	magnet ring frame
	60	magnet ring
25	62	counter weight
	64	vehicle wheel
	66	wheel member
	68	spinner
	70	hex knock off
30	72	adapter base
	74	two bar knock off
	78	assembly plate
	80	voltage regulator
	82	resistor
35	84	cap
	86	reflective coating
	88	image in cap
	90	spokes of a wire wheel
	92	individual wire spoke
40	94	transparent sleeve
	96	integral bar of alloy wheel
	98	alloy wheel
	100	wheel cover
	102	spinner blade
45	104	wheel spinner cover